innervation feeling. Their opponents point out that with the loss of sensibility goes the loss of power to move, making an innervation feeling unnecessary. How can these two classes of facts be reconciled and brought under one law?

In answer to this query, M. Binet has a useful suggestion to offer. It has been shown that among hysterical patients with anæsthetical regions a physical or psychic stimulus increases motor power; acts dynamogenetically, as Féré puts it. May not the opening of the eyes act in the same way with some patients, and this re-enforcement be unnecessary with others? In support of this view is the observed fact that in a patient whose right arm was anæsthetic, and who could not move this arm as desired with her eyes closed, this closure of the eyes had a like effect upon the sound left arm. In both cases the movements were slow, inexact, hesitating, more so with the diseased arm. Intermediate cases occur in which the withdrawal of the eye weakens the power of movement without destroying it, thus showing the characteristic individual variations of this re-enforcing power. Moreover, the movements of anæsthetic limbs have, according to M. Binet, been wrongly interpreted. Although such patients are unaware of passive movements, yet these are physiologically registered in their nervous system. This is shown by the fact that a movement thus passively made by guiding the patient's hand will be reproduced by her voluntarily. She does not know what motions have been made with her hand, but her brain-cells reproduce the same motions. We must admit that movements can be voluntary without being conscious. In conclusion, M. Binet gives the opinion that the supposition of a feeling of innervation acting centrifugally is as yet an ungrounded one, and expects much light from future research.

MEMORY OF MOVEMENTS. — In the *Revue Philosophique* for May, Professor Beaunis describes an interesting series of experiments upon the memory of muscular movements. The experiments form part of a more extended research upon the memory of sense-impressions in general, and are concerned with two questions. The first relates to the accuracy with which the length of lines drawn without the aid of the eyes can be reproduced; the second, to the reproduction of angles under similar conditions. A line is drawn, and, after an interval of from five to fifty seconds, the attempt is made to draw a second line equal to the first, making it with a little stroke to distinguish it from the first. Another method was to make a dot move over a distance and make a second dot; in the reproduction to make a small cross move over an equal distance and make a second cross. In another series two lines were drawn making an angle with one another such as <, and the attempt made to draw another broken line with the same angle. In this test right angles were avoided as being too definite an impression. Care was taken not to have the subject know the results, as this would bring about a more or less unconscious rectification of the errors committed. Professor Beaunis describes his memory as a good one, and mentions that the experiments were made in the evening before going to bed, or when awaking in the night or in the morning, when he was undisturbed by outside noises. The strain of fixing the attention on so minute an impression for more than a few seconds he found very considerable, often inducing feelings of *malaise*. From his observations (to be published in detail later) he draws three general conclusions, confessedly of a tentative character. 1. The memory of the movement does not lapse from consciousness gradually. The memory-image does not fade out little by little, but vanishes more or less suddenly. There is here an analogy with the reverse process, that of recalling a forgotten impression. We have a word on the tip of the tongue, when suddenly it looms into consciousness. 2. When it is no longer possible to recall by a purposive effort the line drawn, — when, for example, one does not even remember whether the angle drawn was acute or obtuse, — the hand will none the less, within a given interval, draw a line closely approximating the original. There is an unconscious memory which in turn loses its accuracy. There is thus a phase of conscious memory, succeeded by a period of unconscious (organic) memory, in turn giving way to a more or less complete forgetfulness. 3. There are sudden variations in the accuracy of the reproductions from one moment to another. These follow no definite law, but are doubtless influenced by variations in subjective conditions.

ELECTRICAL SCIENCE.

Some New Primary Batteries.

AMONG the primary batteries that have lately appeared, two — one an English and one a French invention — deserve special notice. The first of these is an invention of M. Weymersch, and is of the ordinary Bunsen type with zinc and carbon electrodes, the improvement consisting in the employment of a new depolarizing fluid, which greatly increases the constancy of the battery. The Bunsen and bichromate cells give a high electro-motive force; but they are not constant under heavy discharge, the electro-motive force falling considerably. The Weymersch battery, according to some tests published in the London *Electrical Review*, has an almost constant electro-motive force for a heavy discharge extending over a considerable period. For instance: from cells with two zinc plates 6½ by 6⅝ inches, and one carbon plate of the same dimensions, a current of over ten ampères (about 10.3) was taken for thirty-one hours, and at the end of that time the electro-motive force had only fallen a few per cent. The consumption of zinc was only ten per cent more than the theoretical amount, showing that the local action was slight. The inventor proposes to use the battery for the lighting of country houses on a small scale, for torpedo-work, miners' lamps, etc., besides the ordinary uses to which closed-circuit batteries are now put. He calculates that electric lamps aggregating 45-candle power can be supplied for six hours at a cost of eighteen cents per day. Whatever uses it may be put to, it is certain that the tests make an excellent showing.

The other cell, an invention of Mr. O'Keenan of Paris, has been lately described before the New York Electrical Society by Mr. Alfred Shedlock. It is a simple Daniell element, — zinc and copper electrodes in contact with sulphate of zinc and copper respectively. The invention consists in the means employed to keep the strength of the two solutions constant, and a set of cells is arranged to continuously charge storage-batteries from which lamps are supplied. As the electro-motive force of a Daniell cell is about one volt, while that of the Weymersch cell is two volts, twice as much zinc will be consumed in the former as in the latter for the same amount of energy obtained. Mr. Shedlock states that the cost of the zinc and copper sulphate will be at the rate of about one cent per hour for a 12-candle power lamp. If we add the cost of breakage of lamps, interest on investment, depreciation, etc., it will be found that the total cost is at least double this, and lighting in this way would be expensive.

These two batteries are fair types of the improvements that have been recently made in primary cells. Both of them have a field for usefulness, but neither of them can be economically used for lighting or for heavy motor-work.

INCANDESCENT-LAMP EXPERIMENTS. — The following abstract is from the London *Electrician*: "At a recent meeting of the Société Française de Physique, M. Mascart described some interesting experiments which he had carried out with a view of determining how far incandescent lamps might be a source of danger when in the immediate vicinity of inflammable materials. Some 32-candle power incandescent lamps were tightly enveloped in cloth, others in wadding with the gummed surface removed, and others again were placed in the folds of some old stage-scenery. In no case was there any charring or undue heating. An extra thick cotton hood placed over a 32-candle power lamp became charred wherever it was in contact with the globe after ten minutes had elapsed. A 32-candle power lamp which was surrounded by a black silk hood, and then by a black velvet one, set the latter burning gradually in six minutes. In another experiment two lamps were enveloped respectively in black and white wadding from which the gummed surface had *not* been removed; and in two minutes charring commenced, both lamps burst, and the wrappings were set alight. Finally a 300-candle power lamp was laid against some old scenery: in a minute and a half the scenery began to char where the globe touched it, and slowly burnt without flame."

ELECTRICAL RESISTANCE OF COPPER AT LOW TEMPERATURES. — The following note is from *Engineering*: "M. Wroblewski has undertaken to test the truth of Clausius' remark in 1856, that the electrical resistance of chemically pure metals should be

proportional to their absolute temperature; that is to say, if the temperature of a metal could be reduced to absolute zero, its resistance would be annihilated, and its conductivity increase to infinity. M. Wroblewski took advantage of one of the new methods of producing intense cold; namely, that by means of boiling nitrogen at the temperature of its solidification. Wires of copper about $\frac{4}{100}$ of a millimetre in diameter, covered with a double layer of silk, were taken, their conductivity being guaranteed by the makers at ninety-eight per cent of that of pure copper. With this wire M. Wroblewski wound small bobbins having a resistance at ordinary temperatures of about 3 and 20 Siemens units. As the bobbin had to be plunged in liquefied gas, M. Wroblewski began his investigation by studying the electric properties of liquid oxygen and nitrogen. He found that these substances ought to be ranked among the most perfect insulators. The resistances of the bobbins were then measured by the Wheatstone-Kirchhoff method at the temperature of boiling water, ordinary temperature, the temperature of melting ice, the temperature of boiling ethylene at atmospheric pressure (—103°C.), the critical temperature of nitrogen (—146°C.), the temperature of boiling nitrogen under atmospheric pressure (—193° C.), and a temperature nearly that of the solidification of nitrogen (—200°C. to —202°C.). The results are embodied in the following table, where t is the temperature, r the resistance in Siemens units, and a the co-efficient of variation of resistance between two consecutive temperatures: —

Bobbin I.			Bobbin II.		
t	r	a	t	r	a
+100°C.	5.174	—	+23.75°C.	19.251	0.004057
+21.4	3.934	0.004365	0	17.559	0.004263
0	3.614	0.004136	—103	9.848	0.004104
—103	2.073	0.00414	—146	6.749	0.004869
—146	1.360	0.004588	—193	2.731	0.007688
—193	0.580	0.004592	—201	1.651	—
—200	0.414	0.006562	—	—	—

These numbers seem to show that the resistance decreases much more quickly than the absolute temperature of the specimens, and approaches *nil* at a temperature not very far from that obtained by evaporating liquid nitrogen in a vacuum.

UNDERGROUND ELECTRIC-LIGHT WIRES. — Several deaths caused by shocks from electric-light wires have called attention to the dangers of the present systems of high-potential distribution, and much has been written in the daily journals about the deadly electric-light wires. The general remedy proposed is to put the wires underground, and in many cities ordinances have been passed directing that all wires shall be buried within a certain time. In the present state of things it will be impossible to obey these ordinances. There are great difficulties and expenses incident to any general system of underground distribution in our large cities. The enormous number of telephone and telegraph lines that must be put in conduits with the electric-light wires — for the scheme embraces the burying of all wires — introduces the factor of disturbance of messages from induction as well as the great difficulty of preventing leakage between the different lines, and from the lines to the ground. And in New York, where this work is being done on a large scale, the commission which directs it is composed of politicians who have no idea of the mechanical and electrical difficulties that must be met and overcome. Again: it is very much a question whether the putting of arc-light wires under ground will decrease the danger. The wires have still to be taken to the lamps, and in the branch wires there is the same possibility of accident as before. As the case now stands, then, the putting of electric wires under ground will be attended with trouble and expense, possibly with failure. It will not greatly decrease the danger of high-potential lighting, and it will greatly retard its development. At the same time an efficient underground system is much to be desired. It would be as foolish to give up all attempts in this direction as to try to accomplish it at once, without the necessary experience. The best way would seem to be a gradual putting of the wires under ground, instead of a city directing all the wires to be placed under ground by a certain time. Let them order a certain per cent each year, the localities to be determined by people who know something about the subject. In this way experience will be gained in the cheapest manner, and, if it is found practicable, the end will finally be reached without injury to the companies concerned.

NOTES AND NEWS.

THE *Athenæum* of June 30 announces the death at Brighton of Mr. Edmund Gurney. Mr. Gurney had been subject to obstinate sleeplessness, and had had recourse to opiates. It was an overdose of chloroform that led to his accidental death. Mr. Gurney's best known work was his 'Power of Sound,' a very excellent treatise, and one of permanent value. Of late years he has been oftenest before the public by his contributions to the Proceedings of the Psychic Research Society, of which he was the honorary secretary. He was the chief author of the 'Phantasms of the Living,' and the man to whom, more than to any one else, is due the great interest in psychic studies which this society has aroused. Mr. Gurney had committed himself to the telepathic hypothesis, and was busy to the last in developing that theory. However much one may differ from him in his views regarding the problems of psychic research, all must acknowledge to a great admiration for the courage and industry of the scientist venturing boldly into this psychic 'heart of Africa,' and reporting patiently and systematically his adventures in that mysterious region. His loss is a very serious one to the cause to which he had devoted so many years of his life.

— A. C. McClurg & Co. have just issued the first two volumes of the proposed series of The Great French Writers. The publication of this series has been delayed by the fact that the publishers were disappointed with the translations brought out in England, and therefore undertook the expense of entirely new translations. —— A careful and very valuable bibliography of the works of Sir Isaac Newton, with a list of books illustrating his life and works, by G. J. Gray, has just been issued by Messrs. Macmillan and Bowes, Cambridge. The bibliography is divided into ten sections: (1) collected editions of works; (2) the 'Principia;' (3) 'Optics;' (4) 'Fluxions;' (5) 'Arithmetica Universalis;' (6) minor works; (7) theological and miscellaneous works; (8) works edited by Newton; (9) memoirs, etc.; (10) index. —— A new edition of the late Professor Humpidge's translation of Dr. Hermann Kolbe's 'Short Text-Book of Inorganic Chemistry' (Longman's) has been issued. The greater part of this edition was prepared by Dr. Humpidge last summer. Being unable, owing to failing health, to complete the task of revision, he asked Prof. D. E. Jones of the University College, Aberystwith, to undertake it, and to see the book through the press. —— Mr. Leland will shortly send to the printer his work on 'Americanisms,' which will follow on the 'Dictionary of Slang, Jargon, and Cant,' now in the press. It will contain much folk-lore in the form of proverbs, songs, and popular phrases, and also the etymology and history of the words, as far as they could be traced. The work will include an account of American dialects, such as Pennsylvanian Dutch, Chinook, Creole, and Gumbo. —— Nearly the whole edition of Mr. George Seilhamer's 'History of the American Theatre: Before the Revolution,' has been placed; a second volume, 'During the Revolution and After,' is in press, and will be ready in the autumn. Both volumes are published through the Globe Printing-House, Philadelphia. —— Kegan Paul, Trench, & Co. have made arrangements for the publication of a set of half-crown books to be entitled 'English Actors: Ten Biographies.' The series will be under the general editorship of Mr. William Archer, and will include lives of Betterton, Cibber, Macklin, Garrick, the Dibdins, the Kembles, Elliston, the Keans, the Matthews, and Macready. Mr. Joseph Knight will deal with Garrick, Mr. R. W. Lowe with Betterton, Mr. E. R. Dibdin with the author of 'Tom Bowling,' and the editor himself with the Keans. The subjects have been selected so as to cover as completely as possible the whole field of English acting from the Restoration to our own time. —— Mr. W. J. Linton, one of the leading authorities on wood-engravings of the day, has issued a prospectus, with specimen